VOLUME XI NUMBER 8

MADROÑO

A WEST AMERICAN JOURNAL OF BOTANY

Contents

October, 1952

MADROÑO

A WEST AMERICAN JOURNAL OF BOTANY

Re-entered as second-class matter February 19, 1952, at the post office at Lincoln, Nebraska, under the act of March 3, 1879.

Established 1916. Published quarterly. Subscription price $4.00 per year. Completed volumes I to VIII, $5.00 each; volume IX, $6.00; volume X, $7.00; single numbers, $1.00.

Published at 440 South 11th Street, Lincoln, Nebraska

for the

CALIFORNIA BOTANICAL SOCIETY, INC.

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NOTES ON MALVACEAE[1] III. ABUTILON AND PSEUDABUTILON IN THE GALÁPAGOS ISLANDS

THOMAS H. KEARNEY

Many specimens, similar in habit and appearance to *Abutilon umbellatum* (L.) Sweet, have been collected in the Galápagos Islands. One of these, collected on Charles Island by Darwin, was described as *Sida depauperata* Hook. f. and was transferred by Andersson (1853, p. 230) to the genus *Abutilon,* although the combination *Abutilon depauperatum* (Hook. f.) Andersson seems to have been effectively published first by Robinson (1902, p. 173). Garcke (in Andersson ibid.) described as another species *Abutilon Anderssonianum,* based on collections by Andersson on Chatham and Charles islands. This he distinguished from *A. depauperatum* as having acute calyx lobes and fruits of 8 or 9 3-seeded carpels, whereas J. D. Hooker had described *Sida depauperata* as having obtuse calyx lobes and 5 or 6 carpels, these 3–5-seeded. The present writer has seen no specimens of *Abutilon* or *Pseudabutilon* from the Galápagos Islands having obtuse calyx lobes or carpels containing more than 3 seeds.

Robinson (ibid.) listed both *A. Anderssonianum* and *A. depauperatum,* remarking, however, that the latter is "perhaps only a dry soil form of *A. Anderssonianum.*" (The statement should have been reversed, *Sida depauperata* Hook. f. having been the earliest published name of a Galápagos Island *Abutilon* or *Pseudabutilon.)* Under these two names Robinson listed specimens from eight of the islands. Stewart (1911, p. 100) questioned the validity of the characters given by Garcke for distinguishing *A. Anderssonianum,* and reduced the latter to synonymy under *A. depauperatum.* Svenson (1935, p. 243; 1946, p. 465) went farther, reducing both *A. depauperatum* and *A. Anderssonianum* to synonymy under *A. umbellatum* (L.) Sweet, a somewhat polymorphic species that is widely distributed in tropical America, from Mexico and the West Indies to Bolivia.

The present writer would refer to *A. umbellatum* all specimens of true *Abutilon* from the Galápagos Islands which he has had opportunity to examine. These are mostly fewer-flowered and with less umbelliform ultimate divisions of the inflorescence than in what may be regarded as typical *A. umbellatum.* Otherwise they do not seem to differ in any essential character from that species as described by Cavanilles (1785–90, pp. 28–29, t. 6, fig. 3 and t. 129, fig. 2, as *Sida umbellata* L.),

[1]Previous papers with this title were published in Leafl. of Western Bot. 6:51–52 (1950) and 6:165–172 (1952).

MADROÑO, Vol. 11, No. 7, pp. 253-284. July 28, 1952.

Grisebach (1859–64, p. 78), Schumann (1891, p. 373), Standley (1923, p. 750) and Fawcett and Rendle (1926, p. 97), although some of these authors indicated that there may be as many as 10 or 11 carpels in the fruit.

It was discovered by John Thomas Howell that in the type of *Sida depauperata* Hook. f. at Cambridge University, and in several other *Abutilon*-like specimens collected in the Galápagos Islands by himself and by Alban Stewart, the carpels have an internal, tongue-like, horizontal "intrusion" of the dorsal wall more or less completely dividing the cavity, in other words an endoglossum. No trace of such a structure could be found in numerous other specimens from these islands which the writer, following Svenson, would refer to *Abutilon umbellatum*, although, in habit and appearance, the plants with and without an endoglossum are remarkably similar.

The specimens possessing an endoglossum belong, technically, to the genus *Pseudabutilon* R. E. Fries (1908) and, the 3 seeds in the carpels being in one vertical series, to subgenus *Abutilastrum* (E. G. Baker) R. E. Fries. The endoglossum is, however, usually less developed than in most species of *Pseudabutilon*, so that, in most of the specimens, it does not divide the cavity into two nearly closed compartments. In general, it is more like the endoglossum found in several species of *Sphaeralcea*, in which genus the occurrence of this structure seems to be sporadic, as noted by Kearney (1935, p. 13) and by Krapovickas (1949, p. 191).

The Galápagos specimens with an endoglossum, although more like *Abutilon* than *Sphaeralcea* in most of their characters, resemble the latter genus also in having the basal part of the mericarps reticulate. Fries did not mention reticulation in his descriptions of the genus *Pseudabutilon* or of any of the species described in his monograph, although it is indicated in his illustration of a mericarp of *P. longepilosum* R. E. Fries (1908, t. 7, fig. 21). In numerous specimens from Argentina identified by the present writer as *Pseudabutilon callimorphum* (Hochr.) R. E. Fries and *P. Stuckertii* R. E. Fries, the basal portion of the carpel (below the septum) is distinctly although sometimes rather faintly reticulate.

It seems necessary, therefore, to regard *Sida depauperata* as a species of *Pseudabutilon*, differing from the otherwise remarkably similar *Abutilon umbellatum* in the presence of an endoglossum and of reticulation on the basal portion of the mericarps, these being also longer and narrower than in most specimens of *A. umbellatum*[2]. It is not referable to any of the previously published species of *Pseudabutilon*.

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[2]Carpels 7–8 mm. long and less than 2/5 as wide in the Galápagos *Pseudabutilon*, 5–7 mm. long and usually at least half as wide in specimens of *Abutilon umbellatum* from the Galápagos Islands and elsewhere in western South America.

Pseudabutilon depauperatum (Hook. f.) comb. nov. *Sida depauperata* Hook. f., Trans. Linn Soc. London 20: 232 (1847). *Abutilon depauperatum* Anderss. ex Robinson, Proc. Amer. Acad. 38: 173 (1902).

Plant shrubby or suffrutescent; stems up to 1.2 m. long, much-branched, with strictly ascending branches; young stems, petioles, and peduncles more or less densely stellate-tomentose, the old bark pale brown and becoming fissured; leaf blades (the lower ones) up to 18 cm. long and wide, the upper ones successively smaller, from nearly orbicular to deltoid-ovate, acutish to bluntly acuminate, crenulate to crenate-dentate, sometimes obscurely 3-lobed, thin to rather thick, yellowish- or brownish-green when dry, stellulate-pubescent on both surfaces, rather sparsely so above when mature, copiously to densely so beneath especially when young, 7-veined from the base, the veins and veinlets somewhat prominent beneath; petioles of the lower leaves nearly as long as the blades, those of the upper leaves much shorter than the blades; stipules subulate or very narrowly oblanceolate, 4 to 10 mm. long, caducous; inflorescence a leafy open panicle, the flowers mostly in subumbellate clusters of 2 to 6 at the end of ascending peduncles up to 3 cm. long, the pedicels mostly 1–2 cm. long, articulate above the middle; calyx somewhat angulate in bud, 4–5 mm. long in flower, slightly accrescent, densely stellulate-tomentose, cleft to below the middle, the lobes deltoid-ovate, acutely acuminate; petals yellow fading whitish, about 8 mm. long, 5 mm. wide near apex, cuneate-obovate, scarcely clawed, united at base and with the base of the stamen column, veiny, ciliate at base, otherwise glabrous; column stout, glabrous, 3.5–4 mm. long; stamens numerous, apical, the filaments very slender, 1.5–2 mm. long; styles slender, elongate; stigmas small, capitate; fruit short-cylindric, considerably surpassing the calyx, 7-merous, densely stellate-pilose or subhirsute dorsally and on the awns; carpels subgaleate, 2.5–3 mm. wide above the notch, 7–8 mm. long excluding the awns, these 1–2 mm. long, rather stout, erect or somewhat divergent, the carpels with a tongue-like endoglossum at the lower third extending from about one-half way to nearly across the cavity, inconspicuously reticulate on the basal portion, from completely dehiscent on both sutures to indehiscent below the endoglossum both dorsally and ventrally; seeds 3 in one vertical series or sometimes only 2 developing, triangular-reniform, sparsely to copiously papillate, the papillae sometimes in chains.

Known only from the Galápagos Islands, the type (of *Sida depauperata* Hook. f.) from Charles or Santa Maria (Floreana) Island *(C. Darwin* in 1835, Herbarium of Cambridge University); Duncan or Pinzon Island *(J. T. Howell 9822* and ? *Stewart 1965);* Hood or Española Island *(Stewart 1966, J. T. Howell 8716* and ? *8749);* Jervis or Rabida Island *(J. T. Howell 9764);*

Tower or Genovesa Island *(J. T. Howell 10107)*. The specimens queried are immature.

Pseudabutilon depauperatum seems to form a connecting link between the genera *Abutilon* and *Pseudabutilon*. (It is assumed that an endoglossum is always wanting in *Abutilon*, but until this very large genus has been thoroughly canvassed, this remains an assumption.) The doubts expressed by Hochreutiner (1920, pp. 422, 423) as to the importance of the endoglossum as a generic character and the tenability of *Pseudabutilon* as a genus appear to be more or less justified by the discovery of this species which is so *Abutilon*-like in most of its characters.

The species, as indicated in the description, is quite variable. Variation in thickness of the leaves, density of the indument etc. may be attributed to differences in the habitat, but it is less easy to account for variations in the dehiscence of the mericarps. R. E. Fries (1908, p. 96) in his description of the genus *Pseudabutilon* stated that the mericarps are dehiscent to the base ventrally, to the dissepiment (endoglossum) dorsally. The present writer found, however, that in fifteen specimens from Argentina identified by him as *P. callimorphum* and *P. Stuckertii*, eleven had the mericarps indehiscent or only partially dehiscent below the endoglossum both ventrally and dorsally, the remaining four specimens conforming to Fries' description. *Pseudabutilon nigripunctulatum* (Ulbr.) *R. E.* Fries, of Peru, is related to *P. depauperatum*, but has more acuminate and more deeply dentate, black-punctate leaves.

A specimen of *Abutilon Anderssonianum* Garcke in the herbarium of the Riksmuseum at Stockholm, collected by Andersson and presumably part of the type material, was examined by J. T. Howell and by the writer, and the carpels were found to be without an endoglossum. It would appear, therefore, that Svenson was right in regarding *A. Anderssonianum* as closely related to (perhaps only a few-flowered form of) *Abutilon umbellatum* (L.) Sweet. This conclusion was reached also by Prof. Dr. E. Ulbrich, who wrote to Mr. J. T. Howell on December 2, 1935 (translated): "I have again compared *Abutilon Anderssonianum* Garcke with *A. umbellatum* (L.) Sweet. The type material, which Garcke described, is very scanty in our herbarium, but it is undoubtedly identical with *A. umbellatum* (L.) Sweet. I must, therefore, concur with Svenson in referring *A. Anderssonianum* to *A. umbellatum*."

California Academy of Sciences,
San Francisco, California.

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PLANKTON ALGAE OF SOME LAKES OF WHATCOM COUNTY, WASHINGTON

GEORGE J. SCHUMACHER AND W. C. MUENSCHER

Whatcom County, Washington, is the extreme northwestern county of the United States. It is bordered on the west by Puget Sound, on the north by British Columbia, on the east by the main divide of the Cascade Mountains and on the south by Skagit County. In general topography, the ruggedness increases from west to east and varies in elevation from the low coastal area of the Puget Sound Basin to Mount Baker which towers 10,780 feet above sea level. The western part is mostly rolling uplands and alluvial stream valleys, which are replaced by the low rounded foothills in the central area, while Mount Baker and the Cascade Range dominate the western portion.

Three main rivers drain the county (Muenscher, 1941). The western part is drained by the Nooksack River and its three tributaries which originate in the glaciers of Mount Baker and empty into Bellingham Bay. The central and eastern parts of the county are drained southward by the Skagit River and the Baker River system while several streams drain to the north into the Fraser River. Lake Whatcom, the largest natural lake in the county, is drained directly into Bellingham Bay by Whatcom Creek.

The climate of Whatcom County is wet and temperate. The warming influence of the Japanese Current and the protecting heights of the Cascade Mountains help to make the Bellingham area a mild region for its latitude. In a ten year period the highest temperature recorded for Bellingham was 92° F. and the lowest was 2°F. In this same region, over a twenty-five year period, the average annual precipitation was 32.22 inches (U.S.D.A., 1941). Here the snow is usually light and melts quickly, and an average of 250 days of the year have neither rain nor snow (Mangum and Hurst, 1909).

In the higher mountainous altitudes the situation is different, with snowfall and cold wet weather being prevalent for a period of ten months. In the vicinity of Mount Baker Lodge the annual precipitation has averaged 110.96 inches for a period of ten years and in this region snow may persist all year around with some peaks being covered with ice caps or glaciers.

Lakes Studied

Collections were made in eighteen lakes located in the western half of Whatcom County. Lake Whatcom, about twelve miles long, Samish Lake, about four miles long, and Silver Lake, about one mile long, all have considerable stony and sandy shoreline and sandy bottoms. Terrell Lake, which proved to be the most fertile for this study, was drained in an attempt to provide muck land for farming in the early 1920's. This proved unsuccessful, however, and in 1949 a dam was constructed across its outlet and by December, 1950, the lake was again flooded and now covers over 500 surface acres. The other lakes are, for the most part, small and located in glacial depressions. In many places they are bordered by peat bogs. Their shores consist of floating moors and their bottoms are composed of organic or mucky accumulations. Nearly all the lakes support a considerable growth of aquatic flowering plants in shallow areas and near shore. The lakes from which the phytoplankton samples were studied are indicated on the map (fig. 1).

Collections

The initial set of collections was made in the summer of 1929 by W. C. Muenscher. This collection was stored in a dark cabinet until 1948 when G. J. Schumacher used this material as a subject for a master's thesis and found therein a total of 152 species and 49 genera of algae (Schumacher, 1949). This collection did not include any samples from Baker, Barrett and Terrell lakes.

In 1949 Joanne P. Muenscher visited the area and made a second series of collections. This included samples from Judson, Samish, Silver, Whatcom, Willey's and Wiser lakes.

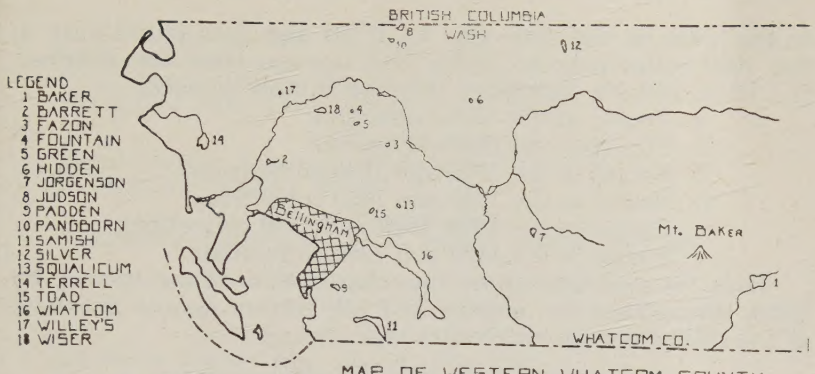

FIG. 1. Location of lakes where algae were collected in Whatcom County, Washington.

The third and final set of collections was made by W. C. Muenscher and Dr. Babette I. Brown during the summer of 1950. Samples were taken from Baker, Barrett, Samish, Silver, Terrell, Whatcom, and Wiser lakes. Thus the material used in this report embraces a time span of twenty-two years, from 1929 to 1950.

The collections were made by using a plankton tow net of No. 20 silk bolting cloth to strain the water. Most of the tows were made in open water in the upper meter and wherever possible several tows were taken in different parts of each lake. The concentrated tows, each representing the strainings from approximately ten liters of lake water, were preserved in five per cent formalin in tightly stoppered bottles until examined. These collections are now filed with the Botany Department of Cornell University.

In any collection of phytoplankton there may be several algae from the benthos. A few algae, not plankton in habit, appeared in these collections. They are included in this study, however, for they may suggest what other types of algae may be found in the depths and about the shores of these lakes.

CLASSIFICATION

The classification of algae is not a clear or definite arrangement. No matter which classification is used, inter-relationships between the separated divisions exist. The system used in the following list is based largely upon that of G. M. Prescott (1951), in which the nature of the cell wall, the pigments found in the cell, the type of reserve food, and the means of reproduction are taken into consideration.

In the following list one or more numbers appear after each individual alga. The numbers correspond with those assigned

to the lakes on the map (fig. 1). If an alga was found only in the 1929 collections no letter will appear after the number, if a letter follows a number this key should be used.

a. Found in the 1949 collection.
b. Found in the 1950 collection.
c. Found in the 1929 and 1949 collections.
d. Found in the 1949 and 1950 collections.
e. Found in the 1929, 1949 and 1950 collections.
f. Found in the 1929 and 1950 collections.

Thus the numbers show the distribution of the species by lakes throughout the county and the letters denote the date of the collections in which they were found.

Division—CYANOPHYTA. Class—MYXOPHYCEAE
Order—CHROOCOCCALES

1. Chroococcaceae

APHANOCAPSA ELACHISTA W. & G. S. West, 1b, 14b.
A. GREVILLEI (Hassel) Rab., 10, 14b, 16a.
A. RIVULARIS (Carm.) Rab., 12, 17.
A. NIDULANS P. Richter, 12a.
A. PRASINA A. Braun, 5.
A. STAGNINA (Sprengel) A. Braun, 8, 10, 11.
CHROOCOCCUS LIMNETICUS Lemm., 6, 8 ,11a, 12c, 15, 16, 17a.
C. MINUTUS (Kuetz.) Naeg., 4, 5, 8, 9, 10, 16, 17.
C. TURGIDUS (Kuetz.) Naeg., 10.
COELOSPHAERIUM DUBIUM Grunow, 12a.
C. NAEGELIANUM Unger, 14b, 16e, 18a.
GLOEOTHECE RUPESTRIS (Lyngb.) Bornet, 8.
MERISMOPEDIA GLAUCA (Ehr.) Naeg., 16b.
M. TENUISSIMA Lemm., 17a.
MICROCYSTIS AERUGINOSA Kuetz., 12a, 17a, 18a.
M. AERUGINOSA var. MAJOR (Wittr.) G. M. Smith, 15.
M. FLOS-AQUAE (Wittr.) Kirchn., 7, 8, 10, 11, 17a.

Order—HORMOGONALES

1. Oscillatoriaceae

ARTHROSPIRA GOMONTIANA Setch., 11.
A. JENNERI (Kuetz.) Stiz., 7.
LYNGBYA SPIRULINOIDES Gomont, 16a.
OSCILLATORIA AMPHIBIA Ag., 9.
O. CHALYBEA Mert., 2b.
O. LIMOSA (Roth.) Ag., 16, 2b, 4, 5, 7, 14b, 18.
O. PRINCEPS Vauch., 2b, 7, 14b.
O.TENUIS Ag., 4, 5, 6, 9, 11, 13, 16f, 17a.
PHORMIDIUM NAVEANUM Grunow, 5.
SPIRULINA MAJOR Kuetz., 11.
S. NORDSTEDTII Gomont, 12.
S. PRINCEPS (W. & G. S. West) G. S. West, 15.

2. Nostocaceae

ANABAENA AFFINIS Lemm., 4, 12a.
A. CIRCINALIS Rab., 5, 10, 18.
A. FLOS-AQUAE (Lyngb.) Breb., 13.
A. LEMMERMANNI P. Richter, 12a, 15, 16d, 18.
A. LIMNETICA G. M. Smith, 13.
A. SPIROIDES Klebahn, 18a.
A. SPIROIDES var. CRASSA Lemm., 5, 13.
A. VARIABILIS Kuetz., 12.

A. sp., 9, 11a, 14b, 16b, 17a.
Aphanizomenon flos-aquae (L.) Ralfs, 18b.
Cylindrospermum minutissimum Collins, 8.
Nodularia Harveyana (Thw.) Thur., 13, 16.

3. Stigonemataceae

Hapalosiphon hibernicus W. & G. S. West, 17a.
H. pumilus (Kuetz.) Kirchn., 8.

4. Rivulariaceae

Gleotrichia echinulata (J. E. Smith) Richter, 14b, 18a.

Division—Chlorophyta Class—Chlorophyceae
Order—Volvocales

1. Volvocaceae

Eudorina elegans Ehr., 2b, 12a, 14b, 16b.
Pandorina morum (Muell.) Bory, 12a, 14b, 16a.
Pleodorina californica Shaw, 18a.
Volvox aureus Ehr., 13.
V. globator L., 13, 14b, 18a.
V. mononae G. M. Smith, 5, 13.

Order—Tetrasporales

1. Palmellaceae

Gloecystis gigas (Kuetz.) Lag., 1b, 2b, 14b.
Sphaerocystis Schroeteri Chod., 12a, 14b, 16d.

Order—Microsporales

1. Microsporaceae

Microspora pachyderma (Wille) Lag., 17a.
M. stagnorum (Kuetz.) Lag., 8, 9.
M. tumidula Hazen, 17.
M. Willeana Lag., 6, 8.

Order—Chaetophorales

1. Chaetophoraceae

Chaetophora elegans (Roth) Ag., 12.

2. Coleochaetaceae

Chaetosphaeridium globosum (Nordst.) Klebahn, 1b, 17.

Order—Oedogoniales

1. Oedogoniaceae

Bulbochaete sp., 1b, 8c, 10, 11a, 12c, 14b, 15, 16, 17c.
Oedogonium clavatum Hallas, 4.
O. suecicum Wittr., 17.
O. sp., 1b, 2b, 5, 7, 8, 9, 12, 13, 14b, 16, 17, 18c.

Order—Chlorococcales

1. Hydrodictyaceae

Pediastrum araneosum var. rugulosum (G. S. West) G. M. Smith, 8a, 10, 14b.
P. biradiatum Meyen, 5, 16a.
P. Boryanum (Turp.) Menegh., 4, 5, 7, 8, 10, 11, 12, 16.
P. Boryanum var. undulatum Wille, 2b.
P. duplex Meyen, 2b, 12a, 14b, 16b.
P. duplex var. coharens Bohlin, 1b, 2b, 14b, 16b.
P. duplex var. gracillimum W. & G. S. West, 12a.
P. integrum Naeg., 6.
P. tetras (Ehr.) Ralfs, 8a, 14b, 17a.
Sorastrum spinulosum Naeg., 14b.

2. Coelastraceae

COELASTRUM CAMBRICUM Arch., 8c, 10, 11, 17a.
C. MICROPORUM Naeg., 11.

3. Oocystaceae

ANKISTRODESMUS FALCATUS (Corda) Ralfs, 8, 12, 17c.
A. FALCATUS var. MIRABILIS (W. & G. S. West) G. S. West. 8, 12, 18a.
DICTYOSPHAERIUM EHRENBERGIANUM Naeg., 14b.
D. PULCHELLUM Wood, 8a, 17a.
DIMORPHOCOCCUS LUNATUS A. Braun, 16c.
KIRCHNERIELLA LUNARIS (Kirchn.) Moeb., 12a, 14b.
K. LUNARIS var. IRREGULARIS G. M. Smith, 12.
K. OBESA (W. West) Schmidle, 10.
NEPHROCYTIUM AGARDHIANUM Naeg., 14b.
QUADRIGULA PFITZERI (Schroder) G. M. Smith, 12a.
TETRAEDON CAUDATUM (Corda) Hansg., 12a.
T. REGULARE var. LONGISPINUM (Reinsch) DeToni, 1b, 14b.

4. Scenedesmaceae

SCENEDESMUS ABUNDANS (Kirchn.) Chod., 7a.
S. ACUTIFORMIS Schroeder, 7.
S. ARCUATUS Lemm., 12a.
S. ARCUATUS var. PLATYDISCA G. M. Smith, 14b.
S. ARMATUS (Chod.) G. M. Smith, 2b, 7, 14b.
S. BIJUGA (Turp.) Lag., 6, 7, 12, 14b, 17.
S. BRASILIENSIS Bohlin, 2b.
S. DIMORPHUS (Turp.) Kuetz., 11, 17a.
S. LONGUS Meyen, 7, 8a.
S. OBLIQUUS (Turp.) Kuetz., 2b, 9.
S. QUADRICAUDA (Turp.) Breb., 2b, 4, 5, 7, 8, 10, 11, 16.
S. QUADRICAUDA var. QUADRISPINA (Chod.) G. M. Smith, 10, 14b.

Order—ZYGNEMATALES

1. Zygnemataceae

MOUGEOTIA sp. 1b, 2b, 4, 8, 12, 15, 16, 18.
SPIROGYRA GRACILIS (Hass.) Kuetz., 9.
ZYGNEMA sp., 1b, 5, 12a.

2. Mesotaeniaceae

SPIROTAENIA CONDENSATA Breb., 8.

3. Desmidiaceae

ARTHRODESMUS SUBULATUS Kuetz., 5.
A. TRIANGULARIS Lag., 5, 17.
A. TRIANGULARIS var. INFLATUS W. & G. S. West, 17a.
A. sp., 1b.
CLOSTERIUM ACEROSUM (Shrank) Ehr., 1b.
C. CUCUMIS Ehr., 4.
C. DIANAE var. ARCUATUM (Breb.) Rab., 8.
C. DIDYMOTOCUM Corda, 17a.
C. INTERMEDIUM Ralfs, 14b.
C. KUETZINGII Breb., 14b.
C. LEIBLEINII Kuetz., 2b, 9, 11.
C. LINEATUM Ehr., 14b.
C. LUNULA (Muell.) Ralfs, 14b.
C. MONILIFERUM (Bory) Ehr., 1b, 2b, 5, 9, 12, 14b.
C. PARVULUM Naeg., 5.
C. PRITCHARDIANUM Arch, 1b, 2b.
C. RALFSII var. HYBRIDUM Rab., 8.

C. STRIOLATUM Ehr., 8.
C. ULNA Focke, 8.
C. sp., 8a, 14b, 18a.
COSMARIUM AMOENUM Breb., 8.
C. BIOCULATUM Breb., 17.
C. BLYTII Wille, 14b.
C. CIRCULARE Reinsch, 14b.
C. CONTRACTUM Kirchn., 16a, 17a.
C. CONTRACTUM var. PAPILLATUM forma MINOR G. M. Smith, 11a, 16a.
C. DENTICULATUM forma BORGEI Irenee-Marie, 14b.
C. DEPRESSUM (Naeg.) Lund., 14b.
C. GALERITUM Nordst., 14b.
C. HAMMERI Reinsch, 9.
C. MARGARITIFERUM Menegh., 16.
C. NOTABILE Breb., 6, 9.
C. OVALE Ralfs, 8a.
C. PORTIANUM Arch., 14b.
C. PSEUDOPYRAMIDATUM Lund., 8.
C. PYRAMIDATUM Breb., 8.
C. RENIFORME (Ralfs) Arch., 18a.
C. RENIFORME var. COMPRESSUM Nordst., 6, 12.
C. SUBCOSTATUM Nordst., 14b.
C. SUBCUCUMIS Schmidle, 12.
C. TAXICHONDRUM Lund., 8.
C. TETRAOPHTHALMUM Breb., 7.
C. TUMIDUM Lund., 8.
C. UNDULATUM var. CRENULATUM (Naeg.) Wittr., 17a.
C. UNDULATUM var. MINUTUM Wittr., 9.
C. sp. 14b, 16b.
DESMIDIUM APTOGONUM Breb., 14b.
D. APTOGONUM var. ACUTIUS Nordst., 14b.
D. BAILEYI (Ralfs) Nordst., 14b.
D. SWARTZII Ag., 13, 16.
DOCIDIUM UNDULATUM Bail., 8.
EUASTRUM AFFINE Ralfs, 8a.
E. ANSATUM Ralfs, 17.
E. BIDENTATUM Naeg., 8a.
E. CRASSUM (Breb.) Kuetz., 8.
E. CUNEATUM Jenner., 8.
E. DENTICULATUM (Kirchn.) Gay, 11.
E. DIDELTA (Turp.) Ralfs, 17.
E. INSULARE (Wittr.) Roy, 14b.
E. INTERMEDIUM Cleve, 8.
E. PULCHELLUM Breb., 8.
E. VALIDUM W. & G. S. West, 8a.
E. sp., 14b.
GYMNOZYGA MONILIFORMIS Ehr., 14b.
HYALOTHECA MUCOSA (Dillw.) Ehr., 12a.
MICRASTERIAS AMERICANA (Ehr.) Ralfs, 17a.
M. APICULATA (Ehr.) Menegh., 8, 14b.
M. APICULATA var. FIMBRIATA forma SPINOSA (Bissett) W. & G. S. West, 14b.
M. DENTICULATA Breb., 17c.
M. DEPAUPERATA var. KITCHELII (Wolle) W. & G. S. West, 8a.
M. MURICATA (Bail.) Ralfs, 5, 8, 16.
M. RADIATA Hass., 1b, 14b, 16.
M. TRUNCATA (Corda) Breb., 17.
NETRIUM DIGITUS (Ehr.) Itz. & Rothe, 17a.
ONYCHONEMA LAEVE Nordst., 1b.

O. LAEVE var. LATUM W. & G. S. West, 14b.
PENIUM LIBELLULA (Focke) Nordst, 8a.
P. NAVICULA Breb., 8.
PLEUROTAENIUM EHRENBERGII (Breb.) De Bary, 8, 14b.
P. NODOSUM (Bail.) Lund., 8.
P. TRABECULA (Ehr.) Naeg., 7, 8.
SPHAEROZOSMA GRANULATUM Roy & Biss, 14b.
SPONDYLOSIUM MONILIFORME Lund., 12a.
STAURASTRUM ANATINUM Cooke & Wills, 4.
S. ARACHNE var. CURVATUM W. & G. S. West, 8.
S. ARCTISCON (Ehr.) Lund., 1b, 2b, 7, 14b, 16.
S. BREVIACULEATUM G. M. Smith, 17.
S. CERASTES Lund., 8.
S. CURVATUM W. West, 1b.
S. CUSPIDATUM Breb., 2b, 12a, 17a.
S. FURCIGERUM Breb., 14b, 16.
S. GRACILE Ralfs, 1b, 3, 4, 5, 11a, 12, 16, 18.
S. HEXACERUM (Ehr.) Wittr., 14b.
S. JOHNSONII W. & G. S. West, 14b.
S. MEGACANTHUM Lund., 8.
S. MUTICUM Breb., 14b.
S. PARADOXUM Meyen, 17a.
S. POLYMORPHUM Breb., 17.
S. SETIGERUM Cleve, 14b.
S. TELIFERUM Ralfs, 8a.
S. TETRACERUM (Kuetz.) Ralfs, 14b.
S. sp., 1b, 8a, 12a, 14b, 16b.
TETMEMORUS BREBISSONII (Menegh.) Ralfs, 17.
T. LAEVIS (Kuetz.) Ralfs, 8.
XANTHIDIUM ANTILOPAEUM (Breb.) Kuetz., 14b.
X. ANTILOPAEUM var. POLYMAZUM Nordst., 1b, 8, 14b, 16.
X. CRISTATUM Breb., 8.
X. CRISTATUM var. UNCINATUM Breb., 14b.
X. FASCICULATUM Ehr., 12a.
X. SUBHASTIFERUM W. West, 14b.

Division—CHRYSOPHYTA. Class—CHRYSOPHYCEAE
Order—CHRYSOMONADALES

1. Synuraceae

SYNURA UVELLA Ehr., 2b, 14b, 16b.

2. Ochromonadaceae

DINOBRYON BAVARICUM Imhof, 14b.
D. DIVERGENS Imhof, 11a, 14b, 16d.
D. SERTULARIA Ehr., 1b, 6, 14b.

Division—PYRRHOPHYTA. Class—DINOPHYCEAE
Order—PERIDINIALES

1. Glenodiniaceae

GLENODINIUM sp., 14b, 17a.

2. Peridiniaceae

PERIDINIUM sp., 1b, 13.

3. Ceratiaceae

CERATIUM HIRUNDINELLA (O. F. Muell.) Dujardin, 1b, 2b, 7, 11a, 12c, 13, 15, 16d, 17, 18c.

SUMMARY

1. This study of plankton algae is based upon collections taken from eighteen fresh water lakes from Whatcom County,

Washington. The collections were made in 1929, 1949 and 1950.

2. A total of 220 species, 67 genera and 23 families was determined.
3. The genera with the largest representation are as follows: *Cosmarium*, 26; *Staurastrum*, 19; *Closterium*, 16; *Euastrum*, 12; *Scenedesmus*, 12.
4. The families represented by the largest number of species are the following: Desmidiaceae, 110; Chroococcaceae, 17; Oscillatoriaceae, 12; Nostocaceae, 12; Scenedesmaceae, 12.
5. Terrell Lake had the most varied algal flora with 70 species, Judson Lake was second with 58 species, and Willey's Lake was third with 40 species.
6. The paucity of literature concerning the fresh water algae of this area has prompted the writing of this paper. Since little or no prior investigation had been conducted on these particular lakes, the species herein reported represent for the most part new records for this locality.

Cornell University,
Ithaca, New York.

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A CYTOTAXONOMIC STUDY OF THE GENUS GERANIUM IN THE WASATCH REGION OF IDAHO AND UTAH

Richard J. Shaw

Within the limits of the small but natural geographical area known as the Wasatch region, the genus *Geranium* has been given much needed intensive field study. The Wasatch region forms the western front of the Rocky Mountain province and extends 200 miles south from the great bend in the Bear River at Soda Springs, Idaho, to the pass south of Mount Nebo and east of Nephi, Utah (Fenneman, 1931) and includes twelve counties within these two states. The collections and the field studies of the species of *Geranium* found in this area, together

with greenhouse studies, are the bases for the taxonomic treatment given herein. In addition, cytological analysis of the genus has also been made, with emphasis placed on chromosome numbers in order to show evidence for and possible origin of polyploidy.

Literature

The first comprehensive monographic study of the North American species of *Geranium* was published by Hanks and Small (1907). This included sixty-four annual and perennial species, thirty-one of which were native to Mexico. In 1912, R. Knuth prepared a world-wide monograph in which the treatment of North American species follows in part the pattern of Hanks' and Small's earlier work. The annual species were treated very briefly and incompletely by Fernald (1935). Jones and Jones (1943) presented a taxonomic revision of the perennial species of the United States and Canada in which eighteen species were recognized.

The first cytological work was done in Europe by Tjebbes (1928) when he published the chromosome numbers of two species (*G. pratense* L., n=12 and *G. sylvaticum* L., n=12). Gauger (1937) submitted a list of chromosome numbers of twenty-three European species of the genus, six of which have become established in North America as weedy annuals.

Material and Methods

Observations of chromosome numbers and behavior were made from pollen mother cells and root tips. Root tips were taken from germinating or potted plants grown from seed or transplanted from the field. In one case the root tips were grown from seeds of a herbarium specimen which was nineteen years old, indicating extraordinary seed viability. Both anthers and root tips were killed and fixed in a fresh solution of absolute alcohol and glacial acetic acid (3:1) for twenty-four hours and then smeared using iron-acetocarmine technique. Most of the temporary mounts were made permanent. All source material is on deposit at the Intermountain Herbarium, Utah State Agricultural College, Logan, Utah, with the exception of one herbarium sheet which is at the Idaho State College Herbarium, Pocatello, Idaho.

Field work was carried on for two summers, principally in the many canyons which cross the Wasatch Mountains from east to west. The specimens collected are in the Intermountain Herbarium, Utah State Agricultural College, Logan, Utah. Additional herbarium specimens from the following sources were studied: Gray Herbarium, New York Botanical Garden, Herbarium of Idaho State College, Herbarium of University of Utah, and Intermountain Herbarium, Utah State Agricultural College.

All of the species of *Geranium* discussed in this study were grown in the greenhouse during 1949 and part of 1950. The main purpose of these greenhouse studies was to check the consistency of various morphological characters which have taxonomic significance. The information thus gained has been included as supporting evidence in the following section.

Results

A detailed study of meiosis and of chromosome morphology was difficult because of the extremely small anthers and chromosomes. Meiotic divisions were not observed in the annual species. In the perennial species, however, several meiotic divisions were seen. Diakinesis was studied in both *G. nervosum* and *G. Richardsonii* (pl. 6, figs. A, B). The pairing of chromosomes appeared normal and complete. The chiasmata are mostly terminalized at this stage, and rod or ring shaped bivalents were the only types observed. At metaphase the bivalents appeared round in polar view and dumb-bell shaped in side view. Later stages of meiosis were also seen, but showed no irregularities.

Little variation in size of somatic chromosomes was noted within a species. The centromeres were difficult to locate; however, most of them appeared to have a median position.

Table 1. Chromosome Numbers of Four Species of Geranium.

Figure	Species	Chromosome number*	Source of material
A	*G. nervosum*	n=26	*R. J. Shaw 68,* Bear Lake Co., Idaho. Anthers collected in the field.
B	*G. Richardsonii*	n=26	*R. J. Shaw 30,* Wasatch Co., Utah. Anthers collected in the field.
C	*G. carolinianum*	2n=52	*R. J. Davis 2290,* Idaho Co., Idaho. Grown from seed.
1	*G. pusillum*	2n=26	*R. J. Shaw 36,* Cache Co., Utah. Grown from seed.

*In the chromosome counts the 2n number indicates that root tips were examined and the n number indicates that meiosis was studied. Only one plant from each collection was examined with the exception of *G. nervosum*. Since the chromosome number of this species has not previously been reported, additional determinations were made on three other collections all from different counties of the Wasatch region.

To separate *G. nervosum* and *G. Richardsonii,* the two perennial species occurring in the Wasatch region, Jones and Jones used the criteria of petal pilosity and color of the glandular pubescence on the pedicels; at the same time, however,

FIG. 1. *Geranium pusillum,* metaphase in root tip division. Camera lucida drawing, × 2000.

they considered these species to have similar range, habitat, and habit. The writer, after extensive herbarium, field, and controlled greenhouse studies, has found petal pilosity to be quite constant in *G. Richardsonii,* but in *G. nervosum* it is variable, covering from one-fourth to three-fourths of the petal. The color of the glandular hairs on the pedicels was also found to be extremely variable, ranging from colorless to purple in both species depending upon locality. Furthermore, there are definite habitat differences. Thus, while the writer agrees with Jones and Jones as to the specific distinction of *G. nervosum* and *G. Richardsonii,* he feels that the criteria advocated by them are insufficient to separate these two entities.

After comparison of all specimens collected during this study, as well as those obtained from other herbaria and those plants grown under controlled conditions in the greenhouse, the writer found that the following morphological characters furnish adequate bases for specific differentiation between *G. nervosum* and *G. Richardsonii:* color of petals, length of mature stylar column (including carpels), and length of seeds. In addition, *G. Richardsonii* is generally found in moist shaded areas especially along fast-moving streams, while *G. nervosum* is a plant of more open xeric sites and is frequently associated with *Artemisia tridentata* Nutt.

DISCUSSION

The chromosome numbers of three species listed by Warburg (1938) do not agree with those here reported. *Geranium carolinianum* was reported by Warburg as 2n=46 or 48. The root tip smears made by the writer showed 52 to be the 2n number (pl. 6, fig. C). Warburg and Gauger (1937) disagree on the count of *G. pusillum;* the former listed 2n=34 and the latter 2n=26. Mitotic counts made in this study agree with Gauger's work (fig. 1). Warburg recorded the n number of *G. Richardsonii* as follows: "n=28?", indicating he was uncertain of his count. In both meiotic and mitotic divisions the writer definitely found that n=26 (pl. 6, fig. B).

For his cytological studies Warburg used sections of root tips and flower buds, whereas the writer used smears exclusively. One explanation for the differences of chromosome numbers is the possibility of two different chromosomal races

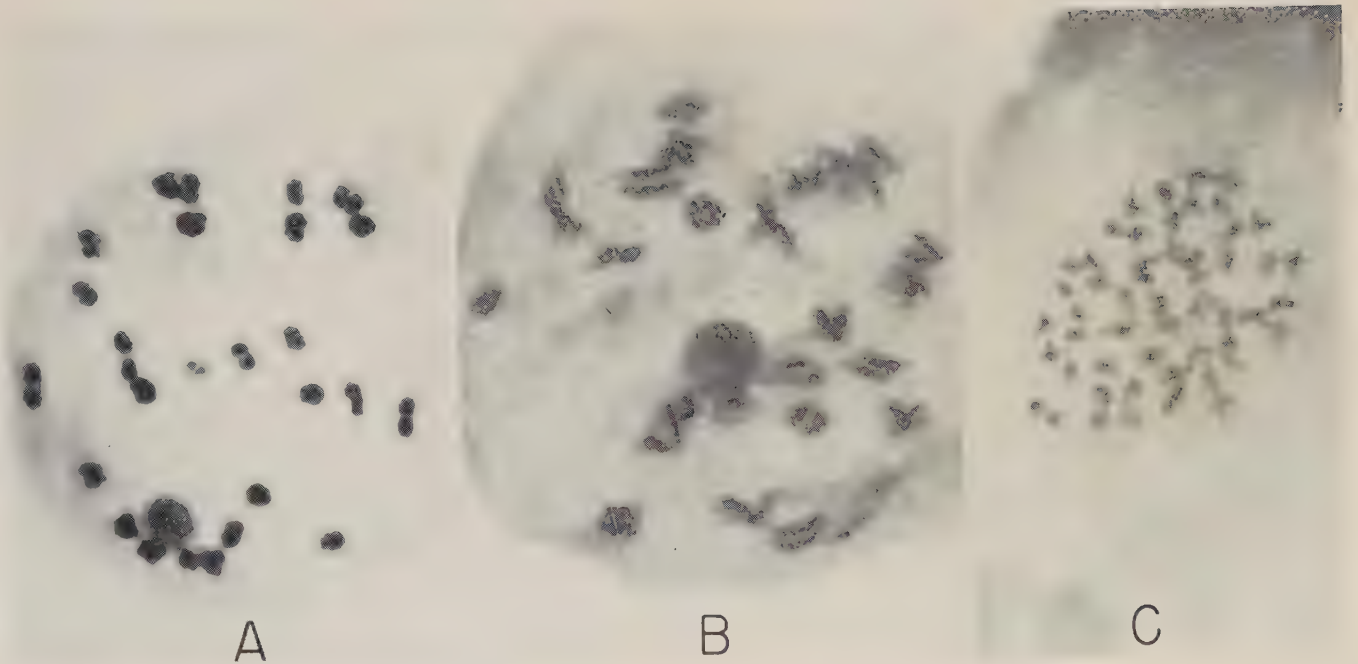

PLATE 6. CHROMOSOMES OF GERANIUM. FIG. A, *G. nervosum*, diakinesis in pollen mother cell division, × 1072. FIG. B, *G. Richardsonii*, diakensis in pollen mother cell division, × 1577. FIG. C, *G. carolinianum*, metaphase in root tip division, × 1072.

within one species or a variety being tetraploid and the rest of the species being diploid. Only further research will clarify these discrepancies.

On the basis of cytological data presented, certain suggestions can be made regarding the nature of polyploidy within this genus. From the figures of the meiotic divisions it can be seen that there are no multivalents present and that pairing is normal and complete (pl. 6. fig. A). Furthermore, fertility of all species is high. These facts suggest that at least the two perennial species, *G. nervosum* and *G. Richardsonii* are tetraploids and are probably the typical allopolyploid types described by Stebbins (1947).

Taxonomy

Key to the Species

Plants annual; petals not more than 7 mm. long.
- Fertile stamens 5; sepals awnless ..... *G. pusillum*
- Fertile stamens 10; sepals awned ..... *G. carolinianum*

Plants perennial; petals more than 12 mm. long.
- Mature stylar column 2–2.5 cm. long; petals usually white; seed 2–3 mm. long ..... *G. Richardsonii*
- Mature stylar column 3–3.5 cm. long; petals rose pink; seeds 3–4 mm. long ..... *G. nervosum*

1. Geranium pusillum Burm. f. Sp. Geran. 27. 1759.

Annual; stems diffusely branched, decumbent or prostrate, puberulent, 1–5 (2) [1] dm. long, base of branches swollen; basal petioles of leaves 10–18 (13) cm. long, puberulent; blade 1–6 (4) cm. broad, orbicular-reniform, 7–9 parted, the division 3–5 toothed or lobed at apex; cauline leaves with short petioles, blades with 3–7 deeply incised segments, otherwise similar to lower leaves; stipules 1–2 mm. long, lanceolate, ciliate on margins; peduncles short, glandular pubescent, 2-flowered; pedicels paired, 2–16 (6) mm. long, bending upward as fruit matures; sepals elliptic to ovate, awnless, 2.5–5 mm. long, minutely glandular pubescent, hispid on the margins; petals purple to violet, about as long as sepals, notched, cuneate; 5 fertile stamens; stylar column 7–9 mm. long, glandular puberulent; carpel bodies 2 mm. long, strigose; seeds 1.5–1.8 mm. long, smooth.

Type locality. England and France.

Range. United States and southern Canada. A weed common in lawns and waste places. Naturalized from Europe.

Representative specimens. Utah. Cache County: North Logan, *Shaw 36;* Logan, *C. P. Smith 17669;* Pelican Ponds, *J. Thieret 149.*

2. Geranium carolinianum L. Sp. Pl. 682. 1753.

Annual; stems 1–3 rather stout and freely branched, erect, 2–4 (2.8) dm. high, closely short pubescent; petioles of basal leaves 5–15 (9) cm. long, short pubescent; blades 3–7 (4) cm.

[1] The number in parentheses indicates the mean measurement.

broad, orbicular-reniform in outline, 5–7 palmately parted and cleft into linear or oblong, obtuse lobes; cauline leaves with varying petioles, 0.5–13 cm. long, blades 3–7 deeply parted, the tips of the segments more acute than the lower leaves; stipules 5–10 cm. long, linear lanceolate; flowers and fruit in compact clusters as a result of the very short peduncles; pedicels 3–15 mm. long, glandular-pubescent, straight at maturity; sepals 5–7 mm. long, ovate, 3-nerved with glandular-pubescence, hyaline, ciliate margin; mucro 1–2 mm. long; petals as long as the sepals, pale pink or whitish, oblanceolate; fertile stamens ten; mature stylar column 12–20 mm. long with glandular hairs; stylodia very short, 1 mm. or less; carpel bodies 3–3.5 mm. long, with villous ascending hairs, black at maturity; seeds 2–2.5 mm. long, oblong, reticulate.

Type locality. Carolina.

Range. Open places or fields throughout North America.

Representative specimens. Utah. Weber County: Fern Hollow, Ogden, *Winona Cardon 313.*

Geranium carolinianum has been confused with *G. Bicknellii* Britton, the latter having been included in the Wasatch region by at least two authors. Inclusion of *G. Bicknellii* in the flora might possibly have been based upon a collection from Logan Canyon in 1910 *(C. P. Smith 2164)*. The stage of the plant's development makes it impossible to determine its true identity.

3. Geranium Richardsonii Fisch. & Trautv. Ind. Sem. Hort. Petrop. 4:37. 1837.

Perennial, the caudex often branched and covered with brownish, withered, scale-like leaf bases and stipules; stems solitary or few, erect, 30–90 (52) cm. tall, glabrous becoming pubescent near the top; petioles of the basal leaves 5–20 (sometimes 30) cm. long, glabrous or glandular tipped hairs or pilose; blades 3–17 cm. broad, pentagonal in outline, deeply 5–7 parted, the rhombic segments divided several times, strigose on the upper surface and on the prominent veins of the lower surface; cauline leaves with short petioles, blades with 3–5 sharply incised segments with tapering lobes, pubescence similar to that on basal leaves; stipules lanceolate, attenuate, 6–12 mm. long, ciliate on the margins; inflorescence cymose, the peduncles 2–10 cm. long, glandular pilose, the glands being either translucent or purple; pedicels slender, 1–3 (rarely 4) cm. long, paired, becoming bent upward as fruit matures, copiously pubescent with short viscid glandular-tipped trichomes; sepals 6–10 mm. long, lanceolate or narrowly oval, glandular-pubescent especially near the base and veins, margins hyaline; mucro 1–2 mm. long; petals 12–20 mm. long, broadly obovate, entire, milk-white or sometimes pink tinted, usually with purple or pink veins, generally pilose on the inside extending

distally from the base for about one-half their length; filaments yellowish green, particularly lower portion, sometimes pink at the tip; mature stylar column 2–2.5 cm. long, glandular-pubescent; stylodia 3–4.5 cm. long, yellowish green; carpel bodies 2.5–4 cm. long, glandular-pubescent along the keel; seeds reticulate, 2–3 mm. long.

Type locality. Valleys of the Rocky Mountains between latitudes 52° N. and 34° N.

Range. Common throughout British Columbia, Saskatchewan and the western United States.

Representative specimens. IDAHO. Bear Lake County: Emigration Forest Camp, Emigration Canyon, *Shaw 69;* Franklin County: Franklin Basin, *Shaw 57.* UTAH. Cache County: Tony Grove Lake, 8000 ft., Logan Canyon, *Shaw 19;* Weber County: 2 miles below junction of Monte Cristo Road and Logan Road, 7500 ft., *Shaw 24;* Salt Lake County: Brighton Camp area, 9500 ft., *Shaw 25;* Wasatch County: Joe Huber's ranch, 3 miles northeast of Midway, *Shaw 30;* Utah County: Mutual Dell, American Fork Canyon, *Shaw 43.*

This species is found in a shady moist habitat especially alongside fast moving streams and rivers.

4. GERANIUM NERVOSUM Rydb., Bull. Torrey Club, 28: 34. 1901. *G. strigosius* St. John, Fl. Southeast. Wash. and Adj. Idaho, 243. 1937 (published originally as *G. strigosior).*

Perennial with branched caudex; stems one to several, erect, 30–115 (70) cm. tall, the lower internodes strigose to densely retrorsely pubescent with whitish non-glandular hairs, occasionally nearly glabrous; petioles of the basal leaves 10–55 cm. long, pubescent like the stem, rarely with glandular trichomes; blades 5–22 cm. broad, with white appressed non-glandular trichomes on both surfaces, especially along the veins, usually pentagonal in outline, deeply 5–7 parted, divisions rhombic in outline with acute incised lobes; cauline leaves smaller, petioles short and blades with deeper incised segments; stipules linear lanceolate with an attenuated tip, 5–20 mm. long, densely puberulent and ciliate along lower margins; inflorescence cymose; peduncles 0.5–6 cm. long, pilose, occasionally interspersed with glandular hairs; pedicels 1–6 cm. long, usually paired, sometimes 3 or 4, copiously pubescent with short viscid glandular tipped trichomes, reflexed and bent upward in fruit; sepals oval, 8–10 mm. long, densely pubescent with glandular trichomes, margins hyaline; mucro 1–2 mm long; petals 1.5–2.3 cm. long, broadly obovate, obtuse, occasionally slightly emarginate, light pink to rose purple with dark purple veins, generally pilose on the inside, the hairs extending distally from the base for one-fourth to three-fourths the length of the petal; filaments purple on upper half; mature stylar body 3–4 cm. long, glandular-pubescent; stylodia 4–5 mm.

long, usually purple; carpel body 5-6 mm. long, glandular-pubescent particularly on the keel; seed reticulate, 3–4 cm. long.

Type locality. Fish Creek, Teton Forest Reserve, northwestern Wyoming.

Range. British Columbia and Alberta to Montana, Wyoming, western South Dakota, Colorado, Utah, Nevada, and northeastern California.

Representative specimens. IDAHO. Bear Lake County: Mink Creek Canyon, 7500 ft., *Shaw 68;* Franklin County: Mink Creek entrance to Cache National Forest, *Shaw 67.* UTAH. Rich County: 2 miles from summit of Logan Canyon, Bear Lake side, 7000 ft., *Shaw 55;* Cache County: Tony Grove Summer Camp, Logan Canyon, *Shaw 46;* Box Elder County: Willard Basin Road, 6000 ft., *Shaw 60;* Weber County: Lookout Point, 1 mile from Monte Cristo Camp area, 9000 ft., *Shaw 20;* Salt Lake County: junction of Silver Fork Road and main highway to Brighton, *Shaw 26;* Utah County: 13 miles up Payson Canyon, Mount Nebo Scenic Loop, *Shaw 74.*

This species is found in open dry areas, especially on hillsides and canyon slopes. Frequently, it is associated with *Artemisia tridentata* Nutt. This pink flowered perennial has been confused with *G. Fremontii* Torr. ex Gray. According to Jones and Jones (1943), however, *G. Fremontii* is restricted to the southern Rocky Mountain Region and is a much smaller plant than *G. nervosum.*

Utah State Agricultural College
Logan, Utah

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CHROMOSOME NUMBERS IN THE GENUS AMSINCKIA

Peter Kamb

The borage genus *Amsinckia,* particularly the group centered about *A. intermedia* Fisch. & Mey., is still a notable taxonomic enigma. I. M. Johnston (1924) opined that "from its exceptional and baffling complexity there seems little hope that students can ever arrive at agreement regarding its treatment." W. Suksdorf (1931) felt compelled to propose some 200 new specific names in the genus, when less than a dozen had been recognized previously; many of the quantitative characters he employed are, however, of doubtful significance. Johnston (1935) has clarified the nomenclature of the genus helpfully, but still describes the *intermedia* group as "variable and bewildering" and "polymorphous."

It was hoped that cytological and genetic information would better characterize natural groups and relationships in *Amsinckia;* accordingly, chromosome counts and a greenhouse program of hybridization were undertaken. The cytological results obtained to date are reported here (table I.). With patience, countable meiotic divisions can be had with aceto-carmine or -orcein squashes of pollen mother cells; living buds or buds previously fixed in Carnoy's chloroform-alcohol-acetic acid mixture are satisfactory. Mother cells and chromosomes are reasonably large. The stage of division best suited to counting varies somewhat with different species; in those with higher chromosome numbers, second metaphase, where the chromosomes are very contracted, seems to be the only feasible stage. The principal difficulty is an inordinate tendency of the cytoplasm to stain and darken; this can be overcome by frequent, repeated destaining with 45 per cent acetic acid after the initial staining with acetocarmine.

There has been almost no investigation of the cytology of this group heretofore. The only report known to the author is that of Strey (1931), who used root tip sections of two specimens identified by him as *A. intermedia* and *A. angustifolia* Lehm. He figured and described the diploid chromosome number of each of these as 32, and believed that a third specimen, *A. lycopsoides* Lehm., also had 2n=32, but could not figure it. Specimens in this last species and in *A. intermedia* are here reported as n=15. One would note that in both of the figures he provided, Strey indicated doubt as to whether certain places, which he counted as two chromosomes, were not actually single ones; the appearance of the figures is such that they might be counted as 2n=30. The number n=16 has not yet been found by us in this group.

It would seem that no evident base number or simple arithmetical scheme is common to the chromosome numbers found thus far among the populations of *Amsinckia* studied. Though

TABLE I. CHROMOSOME COUNTS IN AMSINCKIA.

SPECIES	CHROMOSOME NUMBER	COLLECTION NUMBER	LOCALITY
A. tessellata Gray	n=12	*Reid Moran 3373*	Tehachapi Range, Kern County, Calif.
A. Douglasiana A. DC.	n=12	*Kamb K-88*	Grown from seed, *Kamb 1612*: east of Paso Robles, San Luis Obispo County, Calif.
A. spectabilis F. & M.	n=5	*Kamb K-87*	Grown from seed, *V. Grant 7910*: Pt. Reyes, Marin County, Calif.
A. spectabilis F. & M.	n=5	*C. R. Bell & M. Birdsey*	Pt. Reyes, Marin County, Calif. (15 April 1951)
A. retrorsa Suksd.	n=8	*C. R. Bell 955*	Sierra foothills east of Farmington, San Joaquin County, Calif.
A. retrorsa Suksd.	n=8	*Kamb 1707*	Cache Creek, Colusa County, Calif.
A. lycopsoides Lehm.	n=15	*Kamb 1984*	Near Stockton, San Joaquin County, Calif.
A. intermedia F. & M.	n=15	*Kamb 1983*	Near Stockton, San Joaquin County, Calif.
A. intermedia F. & M.	n=19	*C. R. Bell 954*	Sierra foothills east of Farmington, San Joaquin County, Calif.
A. Eastwoodae Macbr.	n=12	*C. R. Bell 953*	Sierra foothills east of Farmington, San Joaquin County, Calif.
A. inepta Macbr.	n=18	*Kamb K-66*	Grown from seed, *Reid Moran 3053*: San Martin Island, Baja California, Mexico.

all the more interesting on this account, the cytological investigations seem mostly to have created problems rather than solved them. They have shown, however, that populations and species in *Amsinckia* may differ in a more fundamental way than the description "polymorphic" would lead one to believe.

The numbers n=12 in the *A. tessellata* group, n=5 in *A. spectabilis*, and n=8 in *A. retrorsa* promise to be distinctive. An intensive program of counts is anticipated in an attempt to understand better the *A. intermedia* group.

Hybridization experiments have shown that, while it is not possible to cross certain species, in other cases hybrids can be obtained between plants of different chromosome number. It is hoped that the cytological behavior of such hybrids, several of which are being grown in the department greenhouse, will shed light on the significance of the chromosome differences we have found.

The author wishes to express his appreciation to Dr. Herbert L. Mason, under whose direction this work was undertaken.

Department of Botany
University of California, Berkeley

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REVIEWS

A Flora of Santa Barbara, an Annotated Catalogue of the Native and Naturalized Plants of Santa Barbara, California, and Vicinity. By Clifton F. Smith. 100 pp., 6 black and white photographs. 1952. Santa Barbara Botanic Garden. $1.50.

Because of the unique situation of Santa Barbara on California's somewhat nebulous Mason-Dixon line where northern and southern California meet, this annotated list is of far more interest than it might be solely on the bases of its relative completeness, the broad range of habitats represented, and the care with which the author has handled the binomials in the systematic list. Furthermore, Santa Barbara has been a favored collecting area for more than a century, and hence the source of type material collected by Douglas, Nuttall, Gambel, Parry, Brewer, Torrey, Rothrock, Plummer, Cooper, Yates, Elmer, and many others. Their activities in this area are briefly chronicled by Smith. No similar local flora is available for any other section of this boundary area, although it is understood that similar efforts are in progress for all or parts of San Luis Obispo and Ventura counties.

Mr. Smith's area lies for some twenty-five miles along the coastal side of the east-west Santa Ynez Mountains. extending from ocean to crest in an altitudinal range of nearly 4000 feet within a distance of three to six miles. The vegetation consists predominantly of chaparral, with woodland or woodland-grassland in the canyons and on the upper part of the coastal plain. In addition, there are such special habitats as sandy beaches, salt marshes, vernal pools, cliffs, and deposits of diatomaceous earth. There is a high content of introduced species in the herbaceous vegetation at the lower altitudes.

From these diverse environments there has been painstakingly assembled an imposing list of 1018 species (plus 148 varieties and forms), comprising 626 indigenous species and 392 introduced; 173 cultivated escapes are additionally noted. Each inclusion is supported by a cited collection or occasionally by a reference to literature. Most of the collections are the author's and are deposited in the Herbarium of the Santa Barbara Botanic Garden.

The best-represented families appear to be Compositae (148 taxa), Gramineae (102), Leguminosae (67), Cruciferae (40), and Scrophulariaceae (38). Among the largest genera are *Bromus, Lotus, Lupinus, Trifolium, Solanum, Atriplex, Juncus, Carex,* and *Gnaphalium;* in several instances introduced species contribute significantly to the number of species. The conspicuous woody vegetation is represented by rather few genera and species; only two gymnosperms, *Pinus Coulteri* and *Pseudotsuga macrocarpa,* are listed.

From the artistic line-drawing of *Platanus* foliage and fruit on the paper cover, through the handsome full-page photographs of characteristic habitats to the useful gazetteer and the index, this little volume is attractive and thoroughly admirable. Its author is to be congratulated on his meticulously thorough study, and the Santa Barbara Botanic Garden for recognizing the merits of his work and presenting it in such a handsome guise. Lincoln Constance, Department of Botany, University of California, Berkeley.

Native Orchids of North America. By Donovan Stewart Correll. xvi + 400 pages, 146 + 4 plates. 1950. Waltham, Massachusetts: Chronica Botanica Co.; San Francisco: J. W. Stacey, Inc. $7.50.

Orchids have always had a fascination for scientist and layman alike. The amazing complexity of the flower forms tests the skill of the most competent taxonomist, and their weird beauty and difficulty of cultivation attract and challenge the grower.

In this country orchid cultivation has confined itself, with a few notable exceptions, to the exotic forms. Indeed, many orchid growers are unaware of the native species. This is

unfortunate and difficult to understand, for our native Cypripediums (notably *C. acaule* and *C. montanum*) are very nearly the most lovely of their group, far surpassing their tropical relatives in delicacy of texture and coloration, and our native Habenarias, Calopogons, and Spiranthes compare favorably with their exotic relations.

Fifty years ago our native orchids received more attention than they now do, and the orchid flora of the northeast was then well known. In 1924 Professor Oakes Ames wrote a little book for the American Orchid Society that was a compendium of our knowledge of orchids in the United States at that time. Unfortunately this has long been out of print and difficult to obtain. Meanwhile the studies of many workers have increased our knowledge tremendously.

We welcome, therefore, the recent appearance of "Native Orchids of North America" by D. S. Correll. Long connected with the Ames Orchid Herbarium at Harvard University, Dr. Correll has observed and collected orchids throughout the United States and is well equipped to prepare a monograph of the native orchids. In addition, he has been fortunate in having the collaboration of E. T. Wherry of the University of Pennsylvania and J. V. Watkins of the University of Florida, who have contributed cultural notes for the various species. The book is essentially a monograph: synonymy is given for each entity considered, and every species and many varieties are fully illustrated from the pens of Mrs. Oakes Ames and Mr. Gordon W. Dillon. Finally, a glossary of technical terms and a full bibliography are appended.

The author has the happy facility of making even a technical description readable, and scattered here and there are delightful paragraphs which carry one far afield for the moment, to the wooded slopes of the Canadian Rockies or the grassy swamps of Florida. G. P. DeWolf, Jr., Department of Botany, Tulane University, New Orleans, La.

Vegetation of the Sonoran Desert. By Forest Shreve. Carnegie Institution of Washington Publication no. 591. Volume 1, xii + 192 pp., 27 maps, 37 plates. 1951. Washington, D.C. ($3.25 (paper); $3.75 (cloth).

In outlining his plan for study of the vegetation of the arid regions of North America, Dr. Shreve said, "It is only through a study of the plant communities and the dominant perennials in relation to the conditions of climate and soil that the processes can be evaluated which have given the plant life of an area its distinctive character." The present work is the culmination of these studies in the Sonoran Desert, a region of biological unity comprising southwestern Arizona, extreme southeastern California, and the major portion of Baja California and Sonora, Mexico. For the most part, this area lies

below an elevation of 3000 feet. The annual precipitation ranges from well under five inches to about fifteen inches; its amount and seasonal distribution being considered the most important physical conditions limiting the boundaries of the area and in determining the differences between its various subdivisions. Through intensive study of the physiological and ecological behavior of desert plants at the Carnegie Desert Laboratory at Tucson, members of field expeditions into the Sonoran Desert had intimate knowledge of many of the species encountered and were unusually well prepared to make and interpret observations in the field.

After delimiting and characterizing the four areas which he considers as comprising the North American Desert—the Chihuahuan, the Great Basin, the Mojave, and the Sonoran deserts, Dr. Shreve takes up the Sonoran Desert on the basis of its perennial vegetation, delimiting and discussing in detail the seven vegetational subdivisions which he recognizes therein. The ephemeral herbaceous vegetation is discussed apart from the above in a separate chapter.

In the final chapter the distribution, habitat, and ecological characteristics of twenty-six of the commonest plants of the Sonoran Desert are discussed. Subsequent field work, however, has served to extend the known ranges of several of these species considerably beyond that shown on the distribution maps. Such extensions are to be expected in so vast an area where travel is often difficult. In Baja California, for instance, *Larrea tridentata* is abundant on the low plain southwest of La Paz; *Pachycormus discolor* extends inland to the Sierra Giganta east of Comondú, where it is a large, erect tree; and *Viscainoa geniculata* occurs on the Magdalena Plain.

Thirty-seven excellent photographs depict the characteristic vegetation of the Sonoran Desert and a most useful detailed index completes the volume.

It is fortunate for us that Dr. Shreve was able to complete the manuscript before his death. We are indebted, also, to Dr. Ira Wiggins for seeing it through the press. The volume will stand as a fitting climax of a long career devoted to the study of desert plants. Annetta M. Carter, Department of Botany, University of California, Berkeley.

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For classified items see: Chromosome numbers, Reviews. New scientific names are printed in bold face type. Un-annotated entities in floral lists are omitted from Index.